

April 5, 2004

Refer to: HSA-10/CC-61B

Dean L. Sicking, PhD., P.E.
Director, Midwest Roadside Safety Facility
W. 328.1 Nebraska Hall
PO Box 880529
Lincoln, NE 68588-0529

Dear Dr. Sicking:

The Federal Highway Administration allowed conditional use of a two-bolt breakaway post with the Sequential Kinking Terminal (SKT) terminal in Ms. Carol Jacoby's October 30, 2002, acceptance letter CC-61A, but requested an additional test before this post was used with the flared FLEAT terminal. Your March 25, 2004, letter transmitted the results of this additional test as well as a copy of the Midwest Roadside Safety Facility's report entitled "Performance Evaluation of the FLEAT-MGS End Terminal – NCHRP Test No. 3-35."

For this test, the original FLEAT was modified to connect to your Midwest Guardrail System (MGS), a strong post W-beam barrier that has been successfully tested to NCHRP Report 350 guidelines, but has not yet been submitted for formal FHWA acceptance. To match the design features of the MGS barrier, the FLEAT posts were increased to an above-ground height (breakaway height) of 33.5 inches to attain a top rail height of 31 inches, posts 3 through 6 were fitted with the 6-in wide by 12-in deep x 14-in long routed wood offset blocks used throughout the MGS barrier, and the lead section of W-beam was a 16.67-ft long section of 12-gauge W-beam with five pairs of slots on the upstream end of the rail. Use of this initial length section of rail resulted in all rail splices falling midway between the support posts throughout the terminal and the barrier proper, a key characteristic of the MGS design. In addition, the splice bolts used in the breakaway line posts were reduced to a 9/16-inch diameter from the original 5/8-inch diameter bolts. Enclosure 1 shows the layout of the test installation.

Test 3-35 was conducted on a barrier layout with the FLEAT offset 4 feet from the line of the MGS barrier. The 2000P truck was contained and redirected upright. Enclosure 2 is the test summary page from the aforementioned report.

Although the test was run on a FLEAT that was modified as noted above, you wrote that the higher mounting height produces greater deflection in the terminal and is, therefore, more critical than the standard mounting height. I concur with that statement but would note that the use of deeper offset blocks and the positive effect of moving the W-beam splices from a post location to

mid-span are two factors that enhance the performance of the tested design and which are not present when the FLEAT is used to terminate a standard W-beam installation. Nevertheless, based on your test results, I am herewith rescinding the October 30, 2002 conditional acceptance which limited the use of your two-bolt breakaway posts to the SKT terminal and find this design to be fully acceptable for use on the National Highway System with both the SKT and a standard FLEAT installation. The field performance of both terminals using the two-bolt post design should continue to be monitored to verify acceptable crash performance under field conditions.

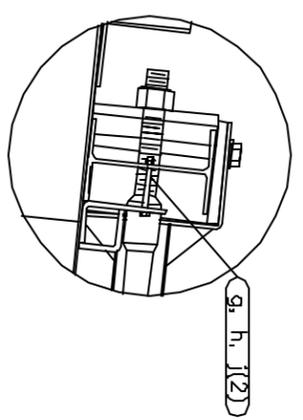
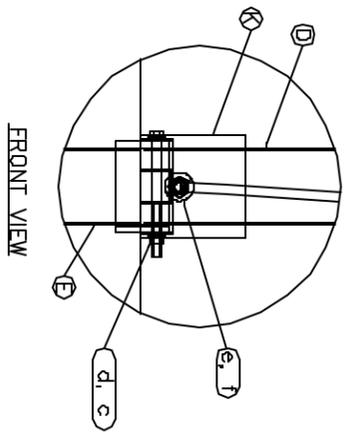
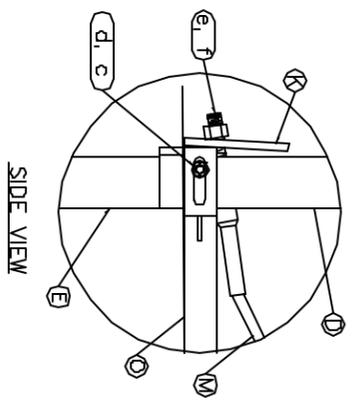
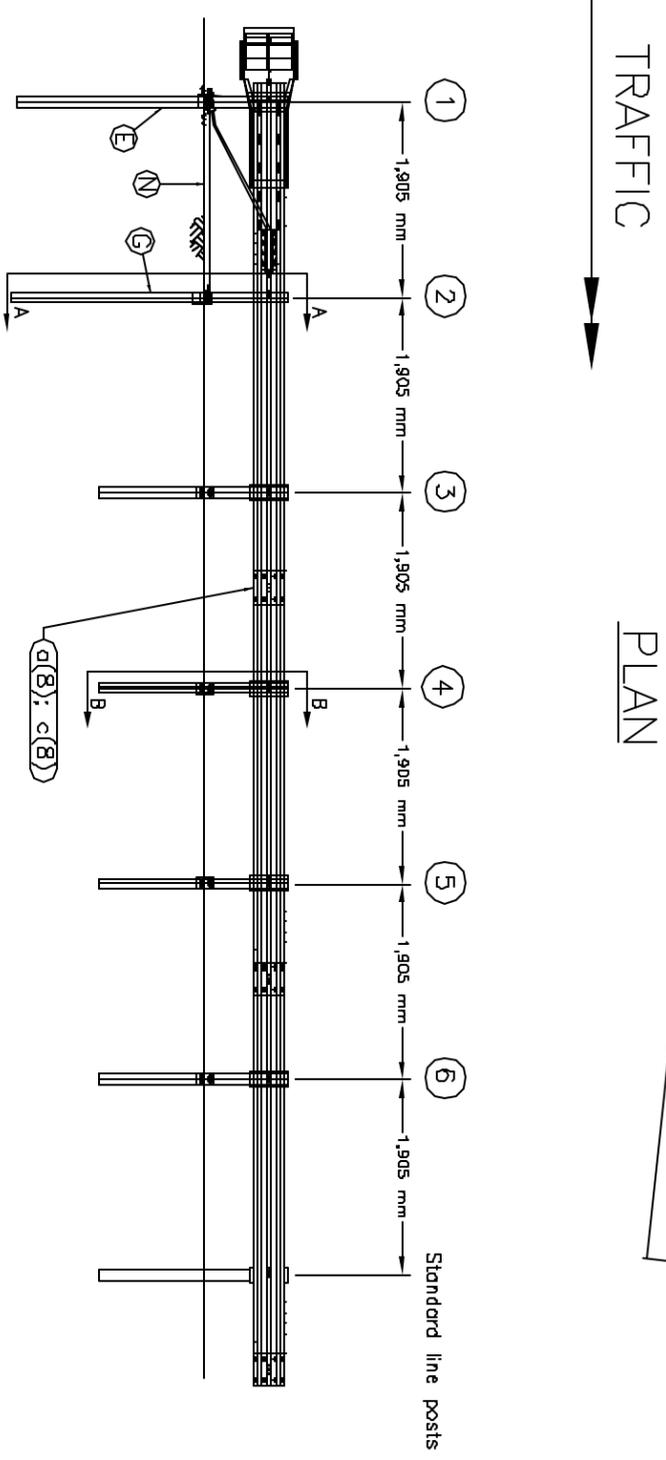
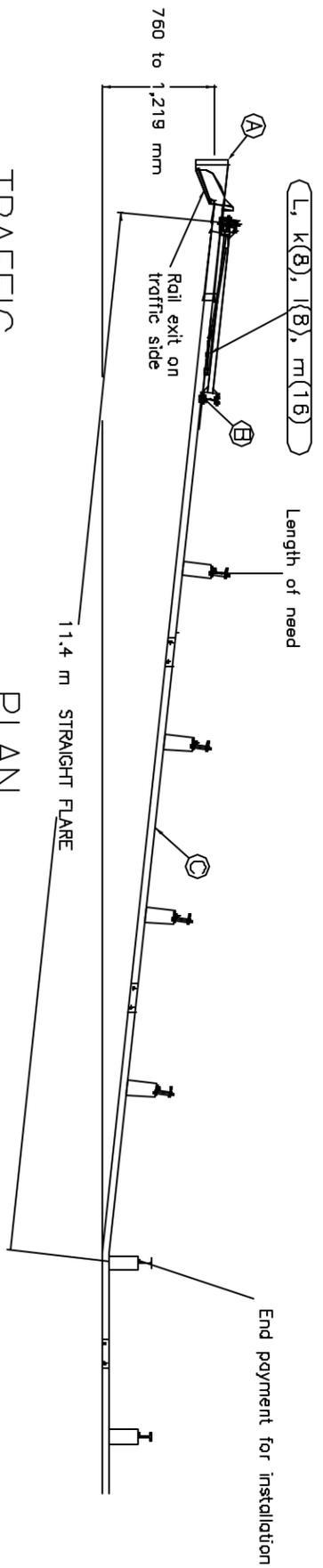
Sincerely yours,

(original signed by Hari Kalla)

for:

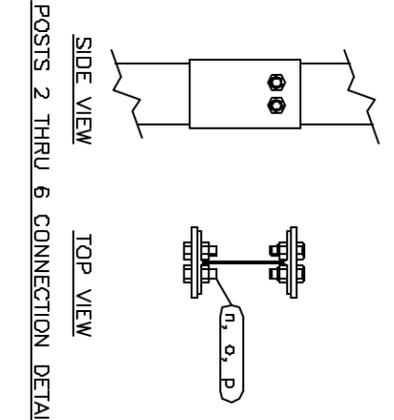
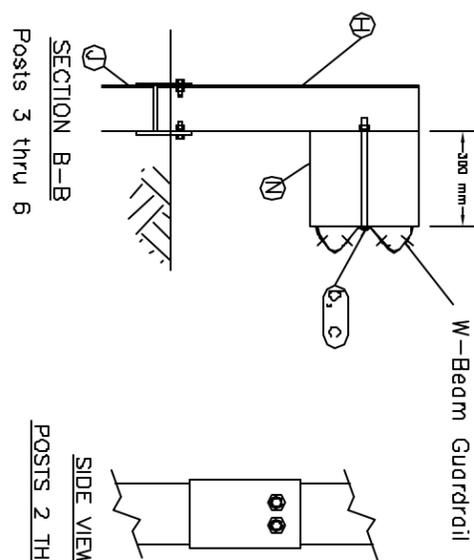
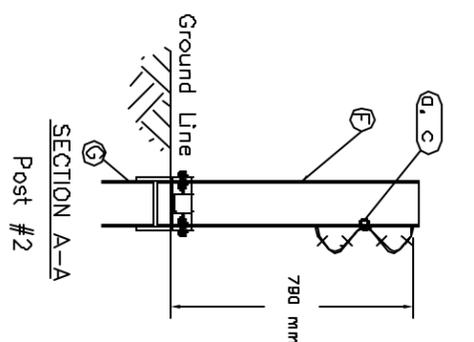
John R. Baxter
Director, Safety Design
Office of Safety

2 Enclosures



POST #1 CONNECTION DETAILS

IMPACT HEAD CONNECTION DETAIL



- GENERAL NOTES:**
1. Breakaway posts are required with the FLEAT.
 2. All bolts, nuts, cable assemblies, cable anchors and bearing plates shall be galvanized.
 3. The lower sections of the posts shall not protrude more than 100 mm above the ground (measured along a 1.5 m cord). Site grading may be necessary to meet this requirement.
 4. The lower section of Post #1 should not be driven with the upper post attached. If the post is placed in a drilled hole, the backfill material must be satisfactorily compacted to prevent settlement.
 5. When rock is encountered, a 200 mm \varnothing post hole, 500 mm into the rock surface may be used if approved by the engineer. Granular material will be placed in the bottom of the hole, approximately 50 mm deep to provide drainage. The first two posts can be field cut to length, placed in the hole and backfilled with adequately compacted material excavated from the hole.
 6. The breakaway cable assembly must be taut. A locking device (vice grips or channel lock pliers) should be used to prevent the cable from twisting when tightening nuts.

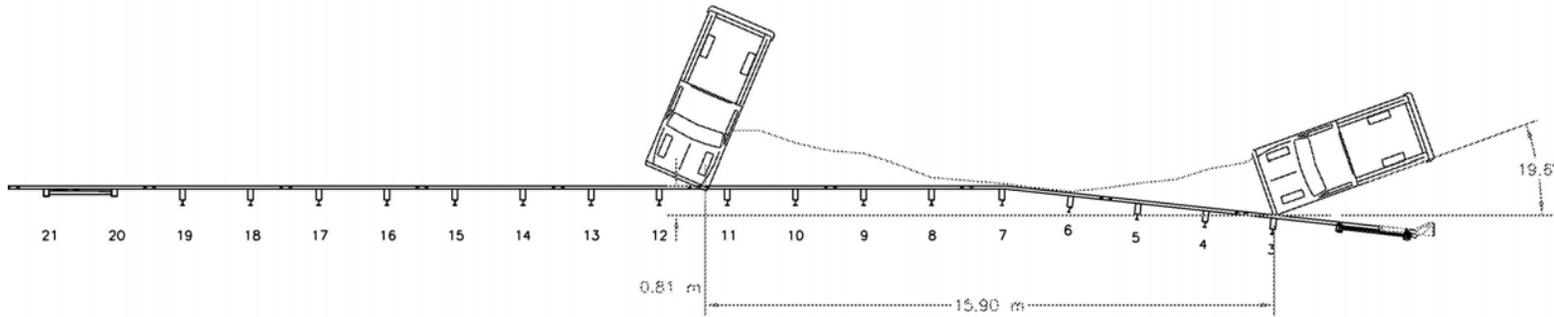
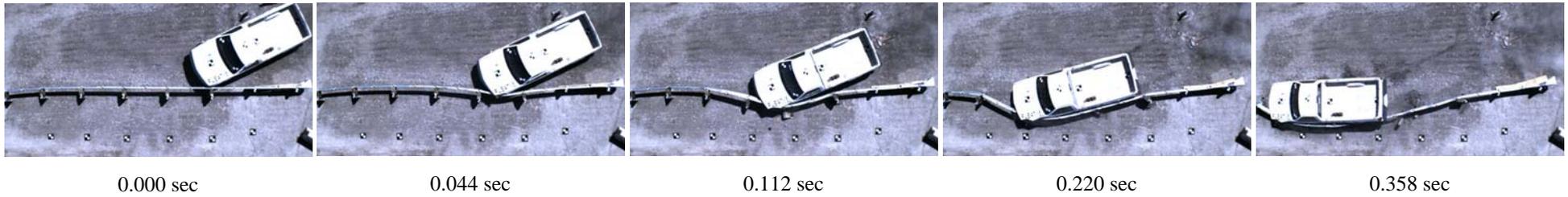
ITEM QTY	BILL OF MATERIALS	ITEM NO.
A	1 IMPACT HEAD	F3000
B	1 W-BEAM GUARDRAIL END SECTION, 12 Ga.	F1303 MGS
C	1 W-BEAM GUARDRAIL, 12 Ga.	G1203 MGS
D	1 FIRST POST ASSEMBLY TOP	HP1A MGS
E	1 FIRST POST ASSEMBLY BOTTOM	HP1B MGS
F	1 SECOND POST ASSEMBLY TOP	HP2A MGS
G	1 SECOND POST ASSEMBLY BOTTOM	HP2B MGS
H	4 BREAKAWAY LINE POST TOP	HP6A MGS
J	4 BREAKAWAY LINE POST BOTTOM	HP6B MGS
K	1 BEARING PLATE	E750
L	1 CABLE ANCHOR BOX	S760
M	1 BCT CABLE ANCHOR ASSEMBLY	E770
N	4 TIMBER BLOCKOUT OR RECYC. EQUIV.	----
O	1 GROUND STRUT	----
HARDWARE (ALL DIMENSIONS IN MM)		
D	9 16 Dia. x 32 SPLICE BOLT, POST #2	B58012Z
B	4 16 Dia. x 356 H.C.R. BOLT (POSTS 3 THRU 6)	----
C	14 16 Dia. H.C.R. NUT	NO50
D	1 16 Dia. x 230 HEX BOLT GRD 5	B5B0904A
E	2 25 ANCHOR CABLE HEX NUT	N100
F	2 25 ANCHOR CABLE WASHER	W100
G	2 6 x 100 HEX BOLT	B140404
H	2 6 HEX NUT	NO14
J	4 6 WASHER	WO14
K	8 CABLE ANCHOR BOX SHOULDER BOLT	SE58A
I	8 13 A325 STRUCTURAL NUT	NO55A
M	16 27 OD x 14 ID A325 STR. WASHER	WO50A
N	20 14 Dia. x 50 HEX BOLT GRD 5	----
O	20 14 Dia. HEX NUT	----
P	20 14 Dia. WASHER	----

RST
Road Systems, Inc.
1100 Highway 17
P.O. Box 100-100
or Phone 800-696-0714

Flared Energy Absorbing Terminal - FLEAT Assembly
Midwest Guardrail System
Hinged Steel Post System

By: JRR
Date: 08/07/04
Sheet: A1

Drawing Name: FLT-S-MGS
Scale: NONE
Rev: 0



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- Test Number FLEAT-5 (3-35)
- Date 7/23/03
- Test Article
 - Type FLEAT-MGS End Terminal
 - Key Elements FLEAT impact head
 - Breakaway steel posts
 - Midwest Guardrail System
 - Orientation Impact at post no. 3
- Soil Type Grading B - AASHTO M 147-65 (1990)
- Vehicle Model 1997 GMC C2500 pickup truck
 - Curb 1,880 kg
 - Test Inertial 1,999 kg
 - Gross Static 1,999 kg
- Vehicle Speed
 - Impact 98.2 km/h
 - Exit NA
- Vehicle Angle
 - Impact (trajectory) 19.6 deg
 - Exit (trajectory) NA
- Vehicle Stability Satisfactory
- Occupant Ridedown Deceleration (10 msec avg.)
 - Longitudinal 6.17 g's < 20 g's
 - Lateral (not required) 6.39 g's
- Occupant Impact Velocity
 - Longitudinal 3.90 m/s < 12 m/s
 - Lateral (not required) 3.57 m/s
- Vehicle Damage Minimal
 - TAD¹¹ 11-LFQ-3
 - SAE¹² 11FZEW2
 - 11LFES2
- Vehicle Stopping Distance 15.90 m downstream
 - 0.81 m to the right
- Test Article Damage Moderate
- Maximum Deflection
 - Permanent Set 1,314 mm
 - Dynamic 1,787 mm
- Working Width 1,838 mm

Figure 24. Summary of Test Results and Sequential Photographs, Test FLEAT-5